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"Language" in the Prelinguistic Child

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BEGINNINGS

My first exposure to studies of child language did not involve children at all. In 1974 I was living in a plantation-style, 37-room mansion on 13 acres of land in the Bronx with a very energetic (i.e., wild) male chimpanzee named Nim Chimpsky, attempting to raise him like a human child as part of a research project being conducted at Columbia University. The goal was to teach Nim American Sign Language (ASL), replicating and extending the pioneering work by Beatrice and Allen Gardner with their chimpanzee, Washoe. The project was headed by Herbert S. Terrace, who had been trained by B. F. Skinner and Thomas G. Bever, a former student of Noam Chomsky. Predictably, these men held radically different views about the nature of language; it was left to me to find a reconciliation of the behaviorist and mentalist perspectives that had eluded their mentors. Despite my relative inexperience, I was utterly convinced that I would achieve this goal. As embarrassing as it now seems, I thought I would reach across the evolutionary abyss and learn the structure of a chimpanzee's reality; I was going to do whatever was necessary in order to "talk to the animals."

Over a period of 3½ years I realized that there was something very wrong with Nim's "language." Although his signing compared very favorably with the reports of other signing apes, it became clear that his language was radically different from that of a child. I, and several other members of the project, began a painstaking attempt to understand the nature of this difference, pursuing two lines of inquiry. First, we began soliciting data from researchers studying hearing and deaf childrens' language acquisition in order to perform comparative analy-

ses. Second, we did a detailed analysis of thousands of hours of videotapes of Nim with his teachers. It was at this time that I first wrote to Roger Brown asking him for portions of his Adam, Eve, and Sarah transcripts and requesting unpublished information about their performance on his question-comprehension tasks. With extraordinary generosity Roger responded with a stack of transcripts and pages of detailed discussion of his findings. Both proved invaluable as we developed methods for analyzing the syntactic, semantic, pragmatic, and discourse characteristics of well over 20,000 of Nim's utterances.

With clinical precision the data analyses revealed that Nim's signing was markedly different from human language in numerous respects. Our conclusions, although disappointing, were unambiguous: Only a few of his 125 signs were ever used regularly (e.g., NIM, MORE, EAT, DRINK, GIVE), and these occurred only in fixed contexts (e.g., eating); of the full semantic range of expression afforded by language, Nim's primary semantic function was requesting (particularly food or other objects present); much of Nim's signing was an exact imitation of his teachers' signs; and his conversational use of signing was wholly inappropriate, as the incidence of signing that was simultaneous with that of his teachers was nothing like that seen in humans at any point in development. Finally, although Nim combined signs into sequences, his utterances lacked syntactic structure. (See Terrace, Petitto, Sanders, & Bever, 1979, 1980, for a detailed account of these findings.)

At this point, we were satisfied that the project had answered some basic questions. Nim's utterances lacked syntactic structure and seemed to be produced by various nonlinguistic response strategies. These conclusions presented new questions, however. First, why were the Nim data so inconsistent with the results from other ape sign language projects? Washoe had been said to have acquired a vocabulary of several hundred signs, which she creatively used to produce novel combinations and answer questions. This question had also occurred to my colleague, Mark Seidenberg, at the time a graduate student of Bever's. Seidenberg had been struck by the gross inconsistencies between the reported behavior of Washoe, who was said to sign, and that of Nim, who obviously could not. The resolution was to be found by performing careful analyses of the published reports on ape language, which led us to the conclusion that there never had been any clear evidence that apes such as Washoe had acquired language; what had occurred instead was the overinterpretation of nonlinguistic behavior much like Nim's (Petitto & Seidenberg, 1979; Seidenberg & Petitto, 1979).

A second question proved more difficult to resolve. Although the Nim findings were important, they largely addressed what the ape could not do. However, they failed to explain *why* he (and the other apes) had not acquired language. I had an inchoate feeling that Nim was missing something fundamental, something more basic than simply an inability to string signs together into structured sequences. I began searching for a vocabulary in which to describe what this might

be. I realized that chimpanzees presented a very curious paradox. It was clear that Nim exhibited a wide range of intelligent behaviors. He was able to solve complex problems involving same-different judgments based on physical identity (e.g., color, shape, size); he sorted objects along various dimensions and showed evidence of a powerful memory (e.g., he could remember where an object was hidden for several days and could lead "blind" caretakers to its location); he appeared to have achieved object permanence and other Piagetian sensorimotor milestones, and he performed well on serial ordering tasks. These findings were consistent with those from other studies indicating that apes are highly intelligent (e.g., Chevalier-Skolnikoff, 1976; Gillan, Premack, & Woodruff, 1981; Menzel, 1974; Premack, 1971, 1976; Van Lawick-Goodall, 1970; Woodruff & Premack, 1981).

At the same time, Nim exhibited this intelligence without the benefit of language. He did not represent any of his diverse experiences with symbols but would perform "on command" to obtain a small set of things that he valued (food, free-play, grooming). He would sign because he seemed to know that signing was valued by his caretakers and that specific movements of his hands (i.e., signing) would terminate a trial and release him from training sessions. Interestingly, he seemed to understand the pragmatic or instrumental function of signing, not the symbolic power of signs themselves. He did not reach out and designate objects, people, or events in the world around him. He did not use linguistic symbols to identify referents as belonging to some class or kind. Nim did not and could not *describe*. The dichotomy between Nim's cognitive capacities—which were considerable—and his linguistic capacities—which were not—had to be explained.

I then happened on Roger Brown's seminal book, *Words and Things* (1958). (Actually, Nim "happened" on Roger's book, and many others, as he tore up two shelves in Bever's office in order to gain access to a fossilized donut.) Few works have influenced me more and I finally began to feel that I had come closer to understanding the essential reason why Nim did not sign. Reading this book, I became aware of the special status of the human naming ability and how much more complex it is than the chimp behavior I had observed. The difference was profound and seemed to lie close to the core of the nature of meaning and reference. Somehow for Nim the power of the linguistic symbol had not been gained. For Nim, meaning seemed to have no role outside of the specific association between a form and its referent that had been explicitly taught to him. I had not succeeded in bringing him to the water fountain as Annie Sullivan had done for Helen Keller. For Nim, signs did not *refer*; he did not have words—signs, or names—for things.

Through Nim's failure, I recognized, in essence, part of what makes us distinctively human. I left the project in 1977 feeling that Chomsky was right: Language represents a species-specific distinct domain of knowledge, separate from other forms of knowledge. It also seemed likely that aspects of human

language (in particular, syntax) could simply not be trained, regardless of the intelligence of the organism. I was also left with a deep interest in theoretical questions concerning the relationship between language and cognition, an interest in the nature of meaning and reference, and a passion for sign language, both as a language in its own right and as a tool for examining fundamental issues in cognitive science and, especially, language acquisition.

Immediately after leaving Nim I went off to work with Ursula Bellugi for a year at the Salk Institute for Biological Studies in La Jolla, California. There, Ursula, Ed Klima, and their team of researchers were conducting innovative research on the structure and grammar of American Sign Language (ASL). I began a linguistic analysis of the acquisition of ASL in profoundly deaf children, specifically, how they acquired knowledge of the morphological use of space in ASL (the linguistic unit most important in anaphoric referencing). This study left me with a feeling of amazement at the natural, effortless, and systematic way in which the children acquired sign language from their deaf parents. The contrast with Nim could not have been greater. I went on to conduct research on the grammar of ASL in William Stokoe's laboratory at Gallaudet College for the Deaf in Washington, D.C., and after 10 months I was off to Harvard.

When I arrived at Harvard in 1979, Roger Brown invited me to join him on the 12th floor of William James Hall, and there I began reading extensively in child language acquisition. It was not uncommon to find studies of child language in which there were no analyses of language data at all. Rather than focusing on formal descriptions of grammatical and semantic structures (as Brown had in his 1973 book), the new focus of research was on the "natural" way in which children's knowledge of a language is "built up" from non-linguistic factors and from their interactions with the environment. It was also common to find journal articles disavowing the claim by Chomsky (e.g., 1965, 1975) and others that language represented a distinct domain of knowledge. Rather, some viewed language as being just one of many behaviors resulting from the emergence of a general capacity to symbolize. Researchers holding this position have sought to demonstrate that infant gestural systems and other motoric activity serve as the prelinguistic foundation on which verbal language forms are "mapped" (e.g., Bruner, 1975; Clark, 1978; Greenfield & Smith, 1976; Lock, 1979; Zukow, Reilly, & Greenfield, 1980). Others have sought to demonstrate that the child's early gestural systems share important symbolic properties with linguistic forms (e.g., Bates, 1976; Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979). Some claimed that grammatical structures were imparted to the child through the sentential and conversational (discourse) structure of parental speech and through the child's social interaction with adults (e.g., Snow, 1972; Keenan & Schiefflin, 1976, respectively). Other researchers, believing that the acquisition of grammatical structures was motivated exclusively by function (or pragmatic force), looked for the prelinguistic, gestural counterparts of such functions (Bates & MacWhinney, 1982). Thus, in the late

1970s it appeared that the focus in language acquisition research was moving away from studies of early language structures to studies involving nonlinguistic variables, with a special emphasis on the central role of prelinguistic gestures. (A recent paper by Golinkoff, 1983, corroborates this view.)

Given my previous research experiences, I found these accounts of language acquisition wholly unconvincing. Whether cognitive, social, or pragmatic factors play a role in language acquisition was not at issue; clearly, all parties agree that they play a major role. However, these accounts failed to respect a distinction between language and other forms of communication. The renewed emphasis on the role of the environmental input and the particular emphasis on gestural precursors to language acquisition failed to capture the properties of language that seemed distinct from other forms of knowledge. These accounts also failed to accommodate a logical point raised by Pinker (1979) and others, who argued that many possible grammars could be induced from the limited corpus of parental utterances that a child hears. Without some "built in" constraints on the process of induction, it does not appear that parental input alone can guide the child in selecting the specific syntactic rules of his or her grammar.

Since beginning my studies of child language acquisition, my goal has been to articulate what I have learned about the uniqueness of the human language capacity both from Nim and from deaf children acquiring ASL. The unifying theoretical focus of my research has been to examine the relationship between language and other forms of nonlinguistic, cognitive capacities in the language acquisition process. In pursuing this issue I have attempted to address a basic question: Is language the expression of a domain-specific mental capacity, or is it one of many expressions of a general capacity to engage in intelligent behavior?

In the remainder of this chapter, I present some evidence supporting the conclusion that language acquisition involves much more than the elaboration of prelinguistic knowledge. Language is a distinct formal system whose components and grammatical structure must be discovered in their own right. When data from both the nonlinguistic cognitive capacities of lower primates and innovative research on language acquisition in signing deaf children are considered, they strongly support the idea that language results from a biologically given, species-specific, distinct mental faculty.

ISSUES IN THE STUDY OF SIGN LANGUAGE

Structure of ASL. Intensive research on sign languages over the past 20 years has disproven three common myths about them: (1) that they are a crude mix of pantomime and concrete gestures, (2) that there is a single, universal sign language used by all deaf people, and (3) that they lack the grammatical organization characteristic of spoken languages. As a result of important and innovative studies by Stokoe (1960), Klima and Bellugi (1979), and others, the basic

organizational structure and grammatical components of ASL, a naturally evolved language that is used by most deaf people in the United States and in parts of Canada, have been identified. Analyses of ASL have revealed that it exhibits formal organization at the same levels found in spoken languages, including a sublexical level of structuring internal to the sign (analogous to the phoneme level; Battison, 1978; Bellugi, 1980; Bellugi & Studdert-Kennedy, 1980; Bellugi & Klima, 1982; Klima & Bellugi, 1979; Stokoe, 1960), and a level that specifies the precise ways that signs must be bound to form signs and signs to form sentences (analogous to the morphological and syntactic levels; Klima & Bellugi, 1979; Marmor & Petitto, 1979; Padden, 1981, 1983; Supalla, 1982; Wilbur, 1979; Wilbur & Petitto, 1983).

The basic similarities between signed and spoken languages having been established, it is now possible to use sign language research to address deeper questions concerning human cognitive and linguistic capacities.

Sign Language and Language Acquisition. Although signed and spoken languages share fundamental properties, they also differ in important respects. First, space and movement (including facial expressions) are the means for conveying morphological and syntactic information in signed languages, but not in spoken languages. The continuous, analogue properties of space and movement are used in ASL in systematic, rule-governed ways. These abstract spatial and movement units are analogous in function to discrete morphemes found in spoken language. The greater potential for nonarbitrary form-meaning correspondences afforded by the visual-gestural modality is exploited in sign languages. In particular, indexical signs point to their referents whereas the forms of iconic signs physically resemble aspects of their referents.

These modality differences allow us to address important issues in language acquisition. In particular, studies of ASL provide a way to resolve a major theoretical controversy concerning the role of prelinguistic gestures in the acquisition of linguistic symbols. Both deaf and hearing children rely on gestural communication prior to language. For the hearing child the transition from prelinguistic communication to spoken language involves a change in modality, whereas for the deaf child the transition to signed language does not; that is, for the deaf child gestures and symbols reside in the *same* modality. In evaluating the importance of prelinguistic gestures in early language acquisition, sign languages provide a unique methodological advantage, because, given a single modality and external articulators, certain developmental processes in language can be directly observed over time. In spoken language, of course, this is not the case; there appears to be an abrupt transition from the use of prelinguistic manual gestures to linguistic (spoken) communication. However, this could be an artifactual consequence of the shift in modality, rather than reflecting a deeper discontinuity between prelinguistic and linguistic knowledge. The basic question, then, is whether the acquisition of linguistic forms will (a) be facilitated by,

(b) be continuous with, or (c) share important symbolic properties with deaf children's knowledge of their extralinguistic communicative functions. In sum, this research provides a unique way to examine whether language derives from general cognitive capacities to think and learn, or whether it involves a domain-specific type of knowledge or faculty.

Objectives. The studies summarized in the following sections are concerned with the young child's transition from prelinguistic gestural communication to linguistic expression, as the strongest claims about the types of knowledge required for language acquisition have been made in regard to developments during this critical period. Findings from three studies are discussed: Study 1 examines the comprehension and production of personal pronouns whose linguistic forms in sign language correspond to their meanings in a one-to-one fashion. Studies 2 and 3 attempt to disambiguate the nature of prelinguistic communication, whether, for example, prelinguistic communicative forms can be used to perform linguistic functions such as naming, and whether children actually comprehend the communicative gestures they produce.

STUDY 1: ACQUISITION OF PERSONAL PRONOUNS

A recent study of the acquisition of personal pronouns in deaf children (Petitto, 1983a, 1983b, in press) provides a striking demonstration of unexpected similarities between the deaf and hearing children's acquisition of language. Three noteworthy features characterize the hearing child's acquisition of pronouns. First, they are acquired in a particular order. Beginning around 16–20 months children begin producing the pronoun *me*, followed by *you* around 22 months, and then third-person pronouns (e.g., Charney, 1978; Leopold, 1939-1949; Macnamara, 1982). Second, prior to this process children use proper nouns (e.g., "Jane do X" instead of "I do X"), rather than use the pronoun *me*. Third, around the time when *you* enters the child's lexicon some children—although not all—engage in systematic pronoun reversal errors. For example, mother might say to the child "Do *you* want to go to the store?" and the child would reply "Yes, *you* want go store." Similarly, the child may understand and produce *me* to refer to the adult rather than to herself; although it is uncommon for symmetrical *you-me* error pairs to co-occur. Some researchers have proposed that these children initially regard pronouns as having fixed or stable referents like names (i.e., *you* = child, or *me* = adult) rather than having changing or "unstable" referents that depend on the speaker role (Charney, 1978; Chiat, 1981, 1982; Clark, 1978).

Although the use of personal pronouns in ASL is constrained by the grammar of the language, they are not formed by arbitrary symbols. Rather, they are represented by pointing directly to the addressee (to intend YOU), or self (to intend I or ME). Thus, the formational aspects of these personal pronouns in

ASL resemble extralinguistic pointing gestures that commonly accompany speech and are used prelinguistically by hearing and deaf children. This provides a means for investigating the deaf child's transition from prelinguistic gestural to linguistic expression because gestures and linguistic units are virtually identical in form.

Given that the forms of personal pronouns in ASL are the same form as prelinguistic pointing gestures common to hearing and deaf children, the following questions arise: How does the deaf child move from the early, unconstrained, and communicative use of pointing gestures to the use of pronominal pointing constrained by the grammatical conventions of ASL? Is the acquisition of linguistically governed pointing facilitated by the child's knowledge of its extralinguistic communicative functions? Finally, given the seemingly transparent meaning of you and me pronouns in ASL, will deaf children learn these relations at an accelerated rate and in a relatively error-free manner?

The children in this study were two, third-generation profoundly and congenitally deaf girls. The children were learning ASL as a first language from their deaf parents; they were of normal intelligence and free of other neurological or physical handicaps. Two types of data were obtained: naturalistic data from ages 0;8 through 2;3 and experimental data from pronoun elicitation tasks for one child (age 1;11; for a detailed account of this study, see Petitto, 1983a).

The results indicated that, despite the transparency of the pointing gestures, deaf children acquire knowledge of personal pronouns over a period of time, displaying errors similar to those of hearing children. Although deaf children begin pointing communicatively at around 9 months, they do not use the pointing form to express YOU and ME until around 17–20 months, the range that hearing children first begin to use verbal pronouns systematically as well. Soon after ME has been established, deaf children gain productive control over the YOU pronoun (around 22–23 months), followed by third-person pronouns (see also Bellugi & Klima, 1981; Hoffmeister, 1978; Kantor, 1982; Petitto, 1983a,b). Like hearing children, they too use full proper nouns prior to the productive use of pronouns despite the fact that they use the pointing form in a rich, varied, and communicative fashion. Surprisingly, the children used the pointing form to refer to aspects of their caretaker's body but seemed to avoid the use of the pointing form to indicate the adult. For example, one child (age 1;11) used the pointing form to refer to a spot on her mother's bathing suit but did not use it to refer to her mother as YOU, not even in an experimental task specifically designed to elicit this and other pronouns. Although the phenomenon of "avoidance" has been noted previously in child language literature (e.g., Ferguson & Farwell, 1975), this case is especially intriguing because the children avoided a particular *function* of a form rather than the *form* itself. Further, like hearing children, the deaf children initially exhibited confusion over which pronouns were appropriate given a particular linguistic context, and they produced pronoun reversal errors (e.g., pointing to SECOND person as in YOU, but intending ME).

This study indicated, then, that despite differences between the modalities that might be relevant to acquisition, both deaf and hearing children showed remarkably similar performance in acquiring personal pronouns. The study provided evidence for a discontinuity in the child's transition from prelinguistic to linguistic communicative systems, even when they share a single channel of expression and the forms are transparent. This initial study also demonstrated how experimental research on sign language acquisition can provide a source of information bearing on theoretical issues in human cognition. The unique properties of sign languages (e.g., the fact that they make use of visual-gestural information expressed using external articulators, the hands) were exploited to provide a clear test of a current hypothesis concerning language learning; specifically, the notion that language is continuous with and directly elaborated out of prelinguistic gestures. The results clarified aspects of the acquisition process that were obscured by the nature of speech. In the next study I describe further research using this basic strategy to evaluate other aspects of the child's acquisition of language.

STUDY 2: GESTURAL PRODUCTION IN HEARING AND DEAF CHILDREN

One of the most compelling aspects of hearing infants' behavior is their spontaneous use of gestures well before the onset of speech. As young as 9 months, infants appear to use pointing, showing, and giving gestures in a wide variety of contexts, performing various communicative functions, including requesting and denoting. Equally interesting is the fact that infants will use these indexical gestures even when they are alone or when they are unaware that they are being observed by adults. Another class of gestures, nonindexical, manual ones, has also received a great deal of attention (e.g., see Bates, Bretherton, Shore, & McNew, 1983). For example, on noticing a hairbrush, most hearing children (around ages 12–13 months) will pick it up and make brushing motions, or, if presented with an empty cup, they will bring it up to their mouths as if to take a drink. Unlike indexical pointing gestures, which can refer to a potentially infinite class of referents, nonindexical, manual gestures appear to stand in a specific relation to particular referents; that is, a child can point to a variety of objects, using a single gesture, but the drinking behavior is only relevant to cups. Many researchers have concluded that these gestures assume an important role in the child's acquisition of language. Several different models have been proposed; all emphasize the relationship between gestures and a particular linguistic function, naming.

As previously noted in the discussion of pronoun acquisition, one view is that children's gestures and motoric activity are both the precursors of and prerequisites to language development. Knowledge of linguistic forms is said to be built up from this prelinguistic foundation in a direct and continuous manner (e.g., Bruner, 1975; Clark, 1978; Greenfield & Smith, 1976; Lock, 1979).

According to a second view, gesture and language are two examples of symbolic behavior resulting from the prior growth of a common underlying cognitive competence (Piaget, 1962; Werner & Kaplan, 1963). Bates (1976), Bates et al. (1979), and Bates, Camioni, & Volterra (1975) have presented the most articulate and thorough view of this position. They argue that the early pointing and giving gestures of children as young as 9 months old reflect important characteristics of language, specifically, the intention to communicate, shared reference with others, and the use of conventionalized behaviors. Each of these characteristics of linguistic communication is thought to be observed, in nascent form, in gestures. Moreover, Bates et al. (1983) assert that a particular linguistic function, naming, develops much earlier than previously thought.

Because Bates and her colleagues find that the functional properties of children's use of verbal naming are positively correlated with the functional properties of children's use of gestures (and with other cognitive measures), they conclude that verbal naming and gesturing must be generated by the same underlying cognitive "naming mechanism" (although the precise nature of this mechanism is not specified). On this view, the 13-month-old child's prelinguistic gestures with objects are not *pre-linguistic* at all. To the contrary, gestures of this type are said to be *names*. For them, naming is outside the linguistic system (and the "vocal channel") and exists as part of the child's general cognitive capacities to symbolize.

Interestingly, Bates et al. (1983) point out two ways in which children's use of gestures with objects differs from their verbal names for things: (a) "the contexts of symbol use" and (b) "the relationship between names and objects." With regard to (a) the young child's manual gestures are not used communicatively the way words are, but primarily in solitary or "private" cognition; that is, although children might pick up a cup on noticing it and hold it up to their mouths as if drinking from it, they do not use such gestures for common communicative functions. With regard to (b) the young child's gestures are object dependent, rather than arbitrary. Children rarely, if ever, produce empty-handed gestures (contrary to what might be expected if these are names); instead their gestures employ the associated object.

Although these differences might seem sufficient to undermine the claim that these gestures are names, Bates et al. minimize their importance, concluding that gestures function as verbal names because they meet the criterion specified in their definition of naming. Yet, in asserting that the young child's early gestures function like verbal names, they have defined names so broadly so as to include gestures. The conclusion that gestures function as names follows tautologically from their definition of naming and rests on their setting aside as unimportant the essential properties of names that do distinguish them from gestures.

A third position uses sign language research as the basis for a reinterpretation of the role of prelinguistic gestures in the hearing child's acquisition of spoken language. Bonvillian and his colleagues (Bonvillian, Orlansky, & Novack,

1983b; Bonvillian, Orlansky, Novack, Folven, & Holley-Wilcox, 1983a) studied the development of ASL in 12 hearing infants of deaf parents. Because these children used gestures "linguistically" from around 9 months of age, about 4 months earlier than hearing children are reported to use their first words, and because such gestures were not observed to occur prior to the linguistic use of signs, Bonvillian denies that prelinguistic gestures are a necessary prerequisite for the use of linguistic symbols. In effect, Bonvillian claims that children are capable of using linguistic symbols much earlier than studies of hearing children have suggested, with the usual delay in the transition from prelinguistic gestures to speech in the hearing child's acquisition of language due to a delay in the development of the speech articulatory apparatus. Because motor control over gesture production is achieved much earlier, signing children exhibit earlier use of language (as claimed by others: Caselli, 1983; McIntire, 1977; Prinz & Prinz, 1979; Schlesinger & Meadow, 1972).

Bonvillian's claims are undercut by serious problems of method and interpretation, and there are several reasons to question the validity of his finding that very young hearing children used gestures as signs. First, Bonvillian et al. did not establish any criteria to distinguish between the "linguistic" and "non-linguistic" use of gestures. Second, there were no criteria for establishing whether the children had mastered particular signs, attributions being based exclusively on the production of a "recognizable" sign. The children were credited with adult-like grammatical and semantic knowledge on the basis of the parent's and experimenters' judgments of the extent to which the children's behaviors resembled ASL signs. Attributions were made, then, on the basis of the *form* of the children's gestures, rather than how they were actually *used*, a procedure problematical on several counts and likely to lead to overattribution. First, the extent to which the children's gestures actually resembled ASL signs is unclear because, according to Bonvillian et al. (1983a) "the children frequently omitted some of the features [of ASL signs] and others were produced incorrectly" (p. 17). Second, the dangers involved in making attributions of linguistic competence merely on the basis of the form of the utterance alone are well known (Bloom & Lahey, 1978; Seidenberg & Petitto, 1979). Finally, Bonvillian et al. (1983a) incorrectly equates knowledge of a language with ability to *produce* linguistic forms and defines "language onset . . . as the acquisition of a productive sign vocabulary" (p. 11). If, however, "language onset" is not associated with the mere production of a vocabulary consisting of a few ill-formed gestures, without regard to the manner in which they are used, and if speech (or sign) is not equivalent to language, his strong claims regarding the precocious use of language among signing children cannot be sustained.

Are Gestures Names?

The research I summarize here raises two broad questions. The first concerns the validity of the claim that some gestures are isomorphic with linguistic names. As

I have already suggested, although both Bates and Bonvillian have noted correspondences between gestures and names, neither have established rigorous criteria to evaluate these two types of communication. The basic question of whether early gestures exhibit fundamental properties characteristic of names has been raised with respect to the behavior of signing apes such as Washoe and Nim. Signing apes are said to be able to name objects but, in the absence of any clear criteria by which to differentiate naming from other types of communication, the claim is difficult to evaluate. The same problem holds in evaluating the relationship between children's early gestures and names.

It is not my intention here to propose a general theory of naming (see, for example, Barwise & Perry, 1983; Frege, 1960; Macnamara, 1982, 1986). My goal instead is to identify briefly some basic characteristics of names that any comprehensive theory of naming must explain, and then to determine whether these characteristics also hold for children's early gestures. Such characteristics involve the three different aspects of names that follow.

Forms. A critical characteristic of names is that they are physically distinct from the objects or actions to which they refer; that is, a behavior cannot simultaneously be a referent and its name. For example, the act of coughing cannot function as the noun cough. Names refer, designate, describe, and categorize classes of objects or actions, but they are not themselves the objects or actions in question. Thus, names are physically independent of that to which they refer. This implies that the use of names will not be tied to presence of the referent object or enactment of the referent action; speaking about a cough, for example, does not require enacting the actual behavior. An important empirical question, then, is whether children's early communicative gestures exhibit this independence of form and referent.¹

Scope of Referring Relations. Names refer to kinds of objects or actions, but the scope of this referring relation is of a particular type.² It can be roughly characterized as follows: (i) a single form is used consistently to designate a class of related referents or *kind*; (ii) the form itself must be consistent, rather than changing across occurrences; (iii) the form is not restricted to particular exemplars of a kind; (iv) if multiple forms are used to refer to a particular referent, each must independently meet conditions (i–iii).

(i) reflects the fact that names designate different types of referents. A name

¹This point in no way excludes iconic signs in ASL.

²In this text when I speak of "names," I am referring only to common nouns. Whereas proper names refer to an individual, common nouns refer to a class of objects or actions. The strongest claims about the linguistic status of children's early gestures have been made with regard to this latter type of names.

can be used for a potentially infinite number of tokens of objects or actions, but the classes of objects or actions are themselves differentiable kinds. Thus, a book is a book and not a picture, even though books can have pictures in them and the word book does refer to a potentially infinite class.³ Moreover, a pad of scratch paper is not a book (but a "pad"), even though it shares critical features of books (pages, binding, etc.). Although the number of tokens of the kind book is, in principle, infinite, the class itself is restricted (to all and only objects that are books).⁴

(ii) underlines the fact that names have stable forms, although these may undergo limited modification as the child's articulation improves. (iii) reflects the fact that, whereas names can be used to refer to particular objects or actions, their use is not restricted to individual objects or actions. Thus, bear cannot be exclusively used to refer to a particular exemplar of the class of bears; run cannot refer to a particular act of running.

In regard to (iv), it is obviously the case that several different names can refer to the same object or action; canary, bird, and animal could all be used for a particular small yellow organism that flies. However, if multiple names are used to index the same referent, each of the names must exhibit characteristics (i–iii). This issue is important because children often use several different gestures in the presence of a particular object (or several different objects); in order to evaluate such behavior, it is necessary to look at other uses of these gestures in order to determine whether they are themselves used systematically in the sense defined by (i–iii).

Gestures, such as pointing, could differ from names, then, by violating one or

³According to some theories (e.g., Macnamara, 1982), common nouns do not actually "refer" to objects. Rather, they refer to kinds, which specify sets of which it is either true or false of a particular object that it is a member of that set. The term *referring* is reserved for other linguistic expressions (proper nouns, indexicals, definite descriptions, and function expressions), which are used with respect to particular objects or individuals. On this view, "book" is not a referring expression because it does not itself refer to a particular book; "Roger Brown" is a referring expression because it picks out a particular individual. There are also several other accounts of naming, in which technical terms such as *refer* and *referring* are used in theory-dependent ways. For example, Barwise and Perry (1983) state that: "We think that, in fact, the ordinary English word REFERS captures rather well an important semantical notion. Through utterances people refer to people, things, times, and places, and the reference of these acts is relevant to the interpretation of the utterances" (page 21). These technical disputes, however, have no bearing on my analysis of children's gestures, and the data I discuss do not mediate between different theories of naming. In the text, the term "referring" is used in a theoretically neutral sense as a cover term for the two types of naming Macnamara has distinguished. Thus, I say that a word such as book "refers" to objects even though this usage is not sanctioned by some theories.

⁴This argument is not refuted by Wittgenstein's well-known observation that there cannot be necessary and sufficient conditions for class membership. The merits of his argument aside, it is nonetheless the case that names are used to differentiate among classes. Questions as to whether there can be strict criteria for class membership are separate from questions as to whether names for such classes are used systematically to differentiate among classes.

more of these conditions. For example, a single gesture could be used for objects or actions of different kinds; similarly, many different gestures could be used with reference to a single object or action even though none of these gestures is used with reference to a particular kind.

Functions. In evaluating children's early communicative behavior, it is necessary to consider the semantic and communicative functions of names. Names serve several semantic functions including identifying, recognizing, describing, and categorizing referents as belonging to a known kind. In effect, to name an object is to assign it to a category; naming involves an implicit assertion that the referent has the properties thought to be true of members of the category.⁵ If gestures are used as names, then, they should exhibit these referring, describing, recognizing, and categorizing functions.

In addition to their semantic functions, names are used for a very wide variety of communicative functions and are not used exclusively in "private cognition." Importantly, names are used to make requests, comment on the world, etc. It might be expected, then, that naming gestures would be used in similar ways. Moreover, names are generally used in combination with other linguistic forms. The extent to which children combine gestures with other gestures (and the relationship this shares with their capacity to combine words, if any) will be of special interest.

Finally, names are not restricted to imitated or routinized contexts. It has been noted in the literature that young children's gestures are "highly susceptible to imitation" (e.g., Bates et al., 1983; see also Piaget, 1962). Thus, prompted social gesturing such as *Hi*, *Bye-Bye*, one-time-only imitations of ongoing activities, and gestures learned and used only in the context of a game, cannot be considered to be names, unless independent evidence can be established that children understand these forms.

Clearly, naming is a complex linguistic function. In order to evaluate whether early gestures function as names, what is required is detailed evaluation of children's gestures along *all* of the dimensions specified previously: only then will we be able to make direct comparisons between the child's use of gestures and their use of verbal names.

⁵Clearly, names have important *grammatical* functions in language. Names belong to grammatical categories. These are important for syntax, because syntactic rules are defined over grammatical categories. Some common nouns take the plural form as well as the indefinite and definite articles, *a* and *the*, respectively. Such grammatical variations are accompanied by semantic variations as well (Macnamara, 1982, p. 5).

Rate of Acquisition

The second question addressed by this research is about differences between the acquisition of spoken and signed languages. Because both Bates and Bonvillian stress the close correspondence between gestures and names, their positions imply that deaf and hearing children's behavior should differ in important ways. For several reasons deaf children might be expected to acquire language more quickly than hearing children. The deaf child might also exhibit less differentiation between linguistic and nonlinguistic use of gesture because both occur in the same modality. Further, the deaf child's early gestures might be different or more elaborate because of exposure to sign language input.

Although the study of personal pronouns demonstrated the child's knowledge of the pronominal use of pointing was not simply elaborated from the child's prelinguistic use of this form—a finding that contradicts Bonvillian as well as Bruner and others—it could nonetheless be the case that indexical and other manual gestures do play an essential role in the acquisition of other linguistic functions, particularly naming. The studies that are described next addressed this possibility. Naturalistic and experimental evidence concerning children's production of gestures was obtained, bearing on four questions: (1) Are the hearing and deaf child's prelinguistic gestures fundamentally similar to verbal (and sign language) naming? (2) Does modality influence the acquisition of names? (3) Are signed languages easier to learn because many of the linguistic signs resemble conventional nonlinguistic gestures (i.e., will the iconicity of some ASL signs facilitate their acquisition by deaf children; what is the role of close form-meaning correspondences in the acquisition of linguistic forms in ASL)? And (4) will the deaf child differentiate nonlinguistic gestures from signs even though both reside in the same visual-gestural mode?

This study focused on three hearing children—two acquiring spoken French and one acquiring English—and three deaf children of deaf parents—two acquiring Langue des Signes Québécoise (LSQ)⁶ and one acquiring ASL. Monthly, 1-hour videotapes of the children and a parent were collected from ages 10 through 20 months. A controlled-elicitation procedure consisting of four tasks was used during each taping session, in order to elicit either indexical or nonindexical manual gestures. Detailed transcriptions of the videotapes were prepared, and the forms, functions, and contexts of hearing and deaf children's gestures were coded to determine their indexical, referential, symbolic, and linguistic status. The data were coded by two independent raters in order to determine whether prelinguistic gestures had the same lexical status as names and the extent to which they facilitated the acquisition process.

⁶LSQ is the native sign language used among French deaf persons in Canada, and especially in Quebec. It is fundamentally distinct from ASL (e.g., lexically, morphologically, syntactically, semantically).

Results

The overall gesture types, including their frequency and use, were strikingly similar for deaf and hearing children throughout development. Both deaf and hearing children produced indexical (pointing) and nonindexical manual gestures. Although indexical gestures occurred throughout the period under investigation,⁷ three distinct types of nonindexical manual gestures occurred within particular time periods: "natural" gestures (around 9 to 15 months, with a peak frequency around 12 months), instrumental gestures (around 12 to 18 months, with a peak frequency around 16 months), and iconic gestures (around 16 to 20 months). Most of the children's nonindexical gestures were produced with objects in hand (around 88% of approximately 3,500 nonindexical gestural tokens). Empty-handed gestures were produced less frequently (10% of all tokens). Of the empty-handed gestures that were produced, the natural and instrumental gesture types occurred most frequently. Empty-handed iconic gestures were exceedingly rare in both hearing and deaf children (around 2% of all tokens); iconic gesturing with objects in hand did not occur. Most of the children's gestures with objects were used in play (and "private cognition"), or in requests; the class of empty-handed gestures were used almost exclusively as requests.

There is little question that some of the children's gesturing was communicative. They appeared to use particular gestural forms (e.g., pointing) with the intent to denote objects in the environment, or to achieve an instrumental goal with regard to these objects. The purpose of the following analysis, then, is not to dispute the claim that prelinguistic gestures have communicative functions. Rather, it addresses the extent to which such gestures are isomorphic with linguistic symbols.

Indexical Gestures

The deaf and hearing children in this study exhibited the same usage of pointing gestures as observed in previous studies (see especially, Bates et al., 1975; Bruner, 1975; Clark, 1978; Petitto, 1983a,b) and is not discussed here at length. Indexical pointing was used in a rich, varied, and communicative manner beginning around 9 months. Between 12–18 months, children used pointing in combination with other pointing forms, natural gestures (such as reaching, grasping, and the open–close gesture described later), and words (or signs). Interestingly, the children *never* combined two nonindexical manual gestures, a finding that has also been observed by Volterra (1981), and one that would have provided important support for claims regarding the "syntax" of children's early gestures (e.g., Bruner, 1975).

What is noteworthy about children's early pointing is that they express themselves in a communicative, intentional, and even referential manner, yet we are still not justified in viewing the gestural means for expressing this intention as

linguistic. The child's use of pointing stands in a very different relationship than do linguistic units and their referents.⁷ Although the pointing form indexed a particular object, it was not used to "stand for" a particular object or class of related objects. In fact, it is used with a large, and seemingly, unconstrained class of objects (recall the previous discussion about properties of names). Thus, despite children's rich communicative capacities, there is clearly something distinct about the linguistic means employed to represent or symbolize objects and events among them.

Nonindexical Manual Gestures

The three types of nonindexical manual gestures ("natural", instrumental, and iconic) are discussed according to their age (and peak frequency) of occurrence.

Ages 9 Through 12 Months. "Natural" gestures occurred during this period; one form, called the "open–close gesture," occurred frequently. Deaf children also produced babbling in sign language. These are discussed in turn.

(i) *"Natural" Gestures.* The children produced a range of gestures that were drawn from their natural activities. These are natural in the sense that they are unlearned and time-locked to ongoing activities. They are not abstract forms used to refer to or classify activities; rather, they are the actual enactment of an activity. These natural gestures include reaching, grasping, grabbing, waving hand(s), throwing, flapping arms, banging, mouthing objects, shaking objects, shaking head, pulling or turning head away, holding or raising hands above head, and pushing and pulling. These natural gestures neither have a "representational component" nor stand in a specific relation to specific objects; rather, they occur frequently across multiple contexts for a very wide variety of objects.

Often the children's gestures occurred as reactions to events rather than serving to encode the actions symbolically. In addition, children are highly adept at this age at imitating social and routinized gestures such as waving good bye,

⁷Some forms of pointing are lexical for deaf children beginning around 18 months (see discussion of personal pronouns in Study 1). There are other ways of discerning the young deaf child's knowledge regarding their use of pointing (i.e., when is pointing a gesture and when is it a sign?). Petitto (1981) observed that the acquisition of demonstrative and locative pronouns (*this*, *that*, and *here*, *there*, respectively) proceeds in the following manner. Deaf children progress from pointing *on* objects, often leaving the signing space to do so, to the grammatical use of pointing towards objects and locations within the linguistic constraints of the signer's signing space. Thus, the child's ability to bring the pointing form within the signing space without contacting the referent is an important aid in determining the shift from gesture to sign for these early deictic pointing gestures. Once the child's pointing conforms to the strict "phonological" spatial constraints of the language (and undergoes other changes such as occurring in combination with other lexical items in a systematic manner), it appears that the form has lexical status for the child.

clapping hands, smacking lips, playing peek-a-boo, and the like. Because these gestures occur across many contexts and are not referential, the young child will inevitably produce both appropriate and inappropriate pairings of actions and objects. Thus, sometimes the child mouths an object "appropriately" (e.g., a toy apple), but other times he or she mouths inappropriately (e.g., a mirror); sometimes he or she produces a banging motion with a hammer and sometimes he or she "hammers" with a sneaker; sometimes the child throws the ball, other times a cupful of milk.

The power of these gestures derives from the fact that adults freely attribute a variety of complex desires, intentions, and knowledge to children based on their interpretation of the context in which the gestures occur. Adults do not interpret children's gestures by how they were used in the past or whether there are consistent correlations between particular gestural forms and their referents. The children's gestures appeared across many contexts, with many different objects. Rather, the context itself was used as the basis for interpreting the gestures. Two types of context-based interpretations were noted by observing the adult's response to children's gestures over many trials. First, parents attribute a *single*, specific meaning to a child's gesture even if the child used a variety of *different* forms in the same context at different times. For example, during a single 1-hour taping session, while seated in his high chair, one 11-month-old hearing child performed the following actions at three different times: reached towards the floor, reached towards the ceiling, and banged on the top of his high chair with both hands. Each was interpreted by the mother as a request to get down. It is not that the mother was necessarily wrong—the child may have wanted to get down from his high chair—but there was nothing in the child's action that directly symbolized this information. And because these particular actions also occurred in many other contexts where getting down was not at issue, they did not stand in particular relation to a particular referent or class of related referents. Further, there was nothing about these forms in relation to this context that would permit a parent (or experimenter) to unequivocally rule out other interpretations, e.g., that the child was intending to convey instead, I want to get *up*, I want to move to the other side of the room, or I want a drink of water to be put on my high chair, etc. In fact, on one of the occasions just mentioned, the child attempted to get back into the high chair after mother had taken him down.

Conversely, the same mother in the same session attributed four different meanings to a waving/swatting motion of the child's right arm and hand (flat hand, spread fingers, path movement from eye level to waist with palm facing downward at endpoint): (1) as a request for more food, (2) as a command to approach the child, (3) as a command to move away from the child, and (4) as the good-bye gesture. Hence, a *single* gesture type is interpreted as having *multiple* meanings. In sum, "natural" gestures cannot be said to function in a manner similar to linguistic symbols.

(ii) *Form and Function of the Open-Close Gesture: Are Signs Acquired Earlier?* One ubiquitous gesture that begins during the 9- to 12-month period warrants special attention; both deaf and hearing children produced this type of gesture in nearly identical ways. It involved a repeated opening and closing of the fingers from an open or curved hand. At times, the children moved their arms up and down while opening and closing their hands; at other times the gesture occurred with the hands raised slightly above eye level. Occasionally, the children looked at their own hands while producing the form, but usually they looked at the object, event, or person that stimulated the occurrence of this behavior. Variations included the use of one hand rather than two, or producing the open-close hand gesture with bent elbows at waist level. Finally, during this period the form was very often accompanied by an interesting and amusing behavior: The young children tended to open and close their feet in conjunction with the opening and closing motions of their hand and fingers.

Detailed analysis of the longitudinal data revealed that this open-close gesture had no communicative function during this period. Instead, it appeared to be a general excitatory, motoric response to diverse stimuli, another example of a "natural" behavior that was part of the child's behavioral repertoire. Strong evidence for this claim comes from a close examination of the contexts in which the form occurred. The behavior did not occur in a systematic or principled fashion; there was no relation between the occurrence of the form and a specific referent or class of referents; nor was there a relationship between the form and a particular function, except as a behavioral indicator of the child's general excitement vis-a-vis some object or event that was occurring in her immediate environment.

As both deaf and hearing children produced it in a variety of contexts and for a wide variety of referents, it cannot be said that the open-close gesture was an early "sign." More importantly, the communicative function of this form could not be said to be a "natural" begging or requesting gesture to receive objects, as young hearing and deaf children would produce the form both before and after desirable objects were in hand.

Why, then, is this gesture worthy of special attention? I believe that this form has been the source of a great deal of confusion in the literature. The open-close hand gesture happens to resemble several actual signs in ASL. There is a close but entirely coincidental correspondence between global aspects of the form of a small class of signs in ASL and the open-close hand gesture: WANT, GIVE, GIVE-ME, GET, TAKE, COME, GO, UP, and DOWN (with raised or lowered arm(s), respectively), MILK, OPEN, BYE-BYE, HI, and WHICH (and others). Not surprisingly, these are some of the very signs that researchers have attributed to young children acquiring ASL based on their assessment of the context. In doing so, researchers have relaxed their criteria for what counts as a well-formed sign, enabling them to interpret the open-close gesture as various signs in ASL.

For example, one researcher (Caselli, 1983) claimed that a 10-month-old deaf infant had knowledge of the following signs: WANT, MILK, GIVE-ME, and even WHICH(!).⁸ In thereby interpreting the reflexive gestures of the child as language, language researchers recapitulate the overinterpretations of parents. Both deaf parents and language researchers who study deaf children report that their deaf children are "signing" as early as 4 months. The basis of such overattributions should now be clear. With respect to deaf children, the temptation to attribute sign status to early gestures is greater than with hearing children because some of the gestures happen to look like signs in ASL. Interpreting the child's gestures as signs is especially compelling when these forms occur with the indexical point, yielding the illusion that the child has produced a "sentence." The mother walks into her hungry baby's room with a bottle of milk in her hand. The baby points at the bottle and in excitation produces a variety of gestures that may include (a) pointing, (b) reaching and grasping, and (c) open-close hand and foot gesturing. It is not difficult to see how the interpretation YOU GIVE-ME MILK could be derived. It may be that children have such thoughts. What I am contesting is that they have a gestural code for representing them. Thus, contrary to the claims by Bonvillian and others, deaf children possess gestures that function as communicative gestures and not linguistic symbols; deaf and hearing children's prelinguistic gestures are remarkably similar; and deaf children do not acquire signs earlier than hearing children acquire words.

Underscoring this conclusion, I recently asked a deaf researcher in my laboratory to transcribe a videotape of a *hearing* boy at ages 10 and 11 months. Only portions of the tape where the child was alone on the screen were viewed by the researcher. She was not told whether the child was hearing or deaf but was only instructed to write down any time she thought the child signed. This was not an ideal methodological procedure, but the results were interesting nonetheless. Based on the hearing child's natural repertoire of gestures (like reaching, grasping, banging), indexical pointing gestures, and the open-close hand gesture, she reported nearly a hundred "sign" utterances, including complex combinations of the type mentioned previously. This overattribution is, of course, reminiscent of a similar problem that occurred in the ape language projects (Seidenberg & Petitto, 1979). The signing apes also exhibited a rich class of natural actions and gestures such as those just reported for children (including reaching, grasping, grabbing, banging, throwing, mouthing, shaking, etc.). Unfortunately, these, too, were termed *signs*. In fact, behaviors of apes and infants (around ages 9 to 12 months) are strikingly similar across many dimensions. In neither case, how-

ever, are these actions and gestures remotely similar to true linguistic symbols or the symbolization process. Indeed, the striking similarities between the "language" of apes and young children appears to be little else than similarities in the overinterpretation of nonlinguistic gestures by adult humans, parents and researchers alike.

(iii) *Linguistically Relevant Sign "Babbling" in Deaf Children.* There is one important difference between deaf and hearing children's hand gesturing. At around 7 to 11 months of age deaf children engage in linguistically relevant sign babbling, in much the same way that hearing children begin to babble vocally. Although deaf children's production of unmodulated vocal babbling has been noted previously in the literature (e.g., Lenneberg, 1967), little attention has been given to their sign babbling. My analysis of the forms, use, and contexts in which sign babbling occurred for the deaf children suggests that these hand movements are not attempts to sign and are wholly unlike the forms and functions of their "natural" and indexical gestures. Rather, they are hand movements that specifically reflect the formational (phonological) features of ASL, especially hand configuration and movement parameters (Petitto, in preparation). Interestingly, deaf mothers consistently responded with *language* to their infants' sign babbling and *action* to their gestures.

Ages 12 Through 16 Months. Beginning around 12 or 13 months the children's use of gestures became more focused on objects, events, and people in their environment. Two types of nonindexical gestures were observed: gestures with objects in hand and empty-handed instrumental gestures.

(i) *Gestures with Objects: Are They Names?* By 13 months the children displayed a striking ability to produce a variety of nonindexical manual gestures with particular objects ("drinking" from an empty cup, "talking" on a toy phone). It is gestures of this kind that have been viewed as functioning in a manner similar to common nouns or names. This has led some researchers to assert that naming is "outside" the vocal (linguistic) channel and exists prior to the onset of vocal words as part of the child's general cognitive capacities (see especially, Bates et al., 1983).

At first, it might appear appropriate to regard such object-related gestures as *names* for things, albeit gestural in form. However, a close examination of the form, function, and content of these gestures suggests that even they do not have the same symbolic status as verbal names. First, not only must an object be present in order for children to produce these gestures, apparently it must be physically in their hands. For this reason alone we can reject entirely the claim that these gestures are symbolic in the same way as verbal/sign names. Second, the children gave no evidence of using these forms to identify and categorize objects as being a member of a known class. The gestures often did not appear to be communicative, the children failing to make eye contact with adults while

⁸I studied the same 10-month-old child (KATE from Study 1). I videotaped the session from which Caselli drew her conclusions. Analyses of the child's "signing" during this session by two deaf adults, the child's mother and myself, revealed that Kate did not demonstrate knowledge of the signs attributed to her by Caselli (e.g., WHICH, WANT, MILK, GIVE-ME).

producing them. Thus, the children seemed to be executing complex actions associated with the objects rather than providing names for things—an insight of Piaget's that I believe to be fundamentally correct. Further, these gestures appear to be indexical in the sense of Peirce (1932) because the motion of each gesture is actually part of its referent. In raising a comb to her head and combing her hair, the child cannot be regarded as explicitly symbolizing the comb. Nor are we justified in regarding this action as "standing for" the comb (or combing)—no more than we would want to label the child's inhaling of air the noun *breath* (or the verb *breathe*).

Nonetheless, Bates et al. (1983) argue that the child's solitary and "object-dependent" (non empty-handed) gestures should be considered as names because they *function* as names. Their argument is as follows. When the child gestures with a cup by bringing it to his or her mouth, he or she is in a sense representing knowledge of what is done with cups (the cup being that which holds liquid and is drunk from). On this view, the child is recognizing and categorizing the cup and identifying it as belonging to a known class, hence naming. This view predicts the following. If children's gestures reflect their knowledge of the functions of objects, thereby exhibiting a kind of gestural naming, then we should not observe children performing these actions with inappropriate objects; there should be little or no function violations. Just as we would expect a particular gestural *form* to stand in a systematic relation with a particular referent or a class of related referents, we would also expect the *function* of referents to stand in a principled relationship with a particular gestural form. Thus, to represent the "stirring" function we would expect the actual objects used to stir to be in some principled relationship to each other: Hence, we would expect a pairing between big and small spoons and the stirring gesture, but not spoons and pencils and the stirring gesture.

However, this is not what occurred. Young children routinely made object-related function violations. Function errors began around 13 months and continued until around 18–20 months, suggesting that object functions must be learned. Although the children would pick up a spoon, place it in an empty cup and "stir," they were also likely to pick up other objects that shared certain critical physical (but not functional) dimensions with spoons and use them as well (e.g., hammer, comb, mirror). Note that the children produced many of the words for objects *prior* to their learning the correct functions associated with the objects. Thus, it appears that the young children's gestures do not necessarily reflect their knowledge of the function of objects but rather more clearly reflect their knowledge of actions associated with them.

In summary, it appears that the most critical difference between manual gestures of the type just described and verbal/sign names were observed by Bates but dismissed: The children do not produce empty-handed manual gestures to stand for referents but produce such gestures—really actions—with the actual objects present and in hand. In addition, the meaning of the gestures can be

understood without special knowledge about the relationship between symbolic forms and their referents; i.e., unlike words, there is a literal, physical resemblance between the action of the gesture and what it is ostensibly referring to. A third critical difference was that the children used objects in ways that did not always reflect their literal, intended functions. Finally, the range of communicative functions that these gestures serve is severely restricted. For example, the child does not use the brush gesture to describe (or comment about) someone brushing her hair; the child does not use the cup gesture to request a drink from mother. Children do *not* describe, request, or use gestures for the myriad of functions that words serve from their onset.

(ii) *Instrumental Empty-Handed Gestures.* Instrumental gestures account for nearly all the children's empty-handed nonindexical gestures throughout this period and beyond. Like natural gestures, their form is unlearned, context bound, and part of the child's natural behavioral repertoire (e.g., reaching, raising arms, open–close hand movements). Unlike natural gestures, the forms now appear to assume general meanings. For example, hearing and deaf children will reliably raise their arms to be picked up and reach (with open–close hand movements) to be given an object.⁹ Further, like the natural gestures, instrumental gestures have a very powerful effect on adults, who respond with attention and/or desired actions.

Instrumental gestures differed from the children's first words and signs in important ways. The "give-me" gesture, for example, is literally the behavior used in the act of receiving (or taking), rather than a schematic representation of it (the child enacts rather than depicts). Moreover, the forms were used exclusively in requests; they were communicative "tools."

Ages 16 Through 20 Months. Beginning around 16 months the children were observed to produce a small class of iconic gestures; these gestures preserved partial information about actions that are associated with objects (e.g., "twisting" motions of the wrist as in opening a jar), but they are not literally the enactment of the designated activity (e.g., the child does not actually open a jar). In short, these gestures contain a representational component. If iconic forms are referential, communicative, and representational, why, then, are we not justified in viewing them as similar to linguistic names for things?

Briefly, the critical difference between the child's use of iconic gestures versus their early use of words is that they are used in reference to objects from different natural categories; that is, they do not pick out natural kinds (Macnamara, 1986). This is wholly unlike even the child's very first notions of word

⁹Highly routinized gestural games, social gestures (e.g., Hello and Bye waving), imitated forms, and one-time-only gestures were excluded from this analysis. The status of these gestures are relatively noncontroversial: Most researchers would not attribute lexical status to them.

meanings. Although children's early word meanings are not the same as adult's, they are constrained in systematic ways. For example, the child will not initially use a word such as table to refer to the same class of objects as the adult. The child's initial hypothesis as to the meaning of table is only partially correct; he or she will sometimes over or underextend the range of referents for a particular word. However, this process is not arbitrary. As Carey (1982) notes, "The child would never judge table to mean something like 'table and meal' because table is an object and meal is an event: a concept's including just a specific object and a specific event violates certain conceptual naturalness" (p. 381). Several other factors distinguish iconic gestures from words and signs. The use of iconic gestures is a relatively late development (around 16–20 months) compared with children's first words and signs (around 12 months). Importantly, iconic gestures typically do not occur until *after* the child has acquired the corresponding word or sign. Further, they occur with low frequency and nearly always to supplement a verbal/sign message during requests.

Finally, the deaf and hearing children's first signs and words (respectively) occurred around the same time, between 12 and 20 months; no child in this study began uttering words or signing prior to 12 months.

In sum, then, several findings characterize this second study. Beginning around 9 months, the children produced indexical and nonindexical manual gestures. A detailed analysis of the forms, functions, and contents of the children's early gestural forms and the parent's responses to them revealed that they appear to have radically different properties than words (or signs). Deaf children's gestures are not more elaborated and advanced than hearing children. Even though deaf children are being exposed to a language where both linguistic and gestural information are transmitted in a single channel and are produced with identical units (hands moving in space), the manner in which they acquire this system compels the surprising conclusion that they differentiate between linguistic and nonlinguistic uses of gesture; thus, these forms of expression appear to be constrained by distinct domains of knowledge. Finally, the modality of language transmission does not seem to facilitate the language acquisition process, nor does the child seem to be aided by the iconic (nonarbitrary) form of some signs. With the exception of sign babbling, the deaf children produced gestures that were nearly identical in form and function to those of hearing children, and they were not more advanced despite the fact that sign languages are constructed in such a way as to lend themselves to this unique type of iconic (nonarbitrary, pictorial), gestural elaboration.

STUDY 3: GESTURAL COMPREHENSION

The results of a third study are particularly revealing with regard to the linguistic status of children's early gestures. This experiment examined the comprehension of gestures among hearing and deaf children who had acquired significant spoken or sign vocabularies, respectively. Recall again the various positions arguing that

there should be a close relationship between the child's vocabulary and the gestures he or she produces. Specifically, one view predicts that the child's earliest verbal or sign vocabulary should be preceded by corresponding gestural forms. A second predicts that the child should simultaneously possess gestural and spoken (or sign) forms for objects, people, or events in his or her world. And a third position predicts that the gestures of infants exposed to sign language should possess the properties typically associated with later words.

All three positions imply that children should comprehend the gestures that they themselves produce; that is, if knowledge of the semantic (and syntactic) role of lexical forms shares fundamental symbolic properties with gestural behavior, the speaking (or signing) child should already comprehend gestures by the time he or she can understand the corresponding spoken (or sign) name. Given the close relationship between gesture and sign in a sign language, related questions include: Will the deaf child exhibit greater mastery of gesture comprehension? Does the deaf child clearly differentiate between linguistic and nonlinguistic uses of gesture? Will the deaf child systematically misinterpret gestures as signs?

The children studied were acquiring spoken English or French and (deaf) children acquiring ASL. They were tested at 6-month intervals between 22–48 months, 3 deaf and 3 hearing per group per interval.

Four categories of stimuli were constructed consisting of three groups of gestures and one group of ASL signs:¹⁰ (1) *Gestures Resembling Signs* included gestures that are nearly identical in form to actual ASL signs for a target object (e.g., the pantomime of "brushing one's own hair" is very similar to the sign BRUSH); (2) *Pure Gestures* are unambiguous pantomimes that do not correspond to ASL signs (e.g., the conventional pantomime for banana, a peeling activity, is unlike the ASL sign for BANANA or any other ASL sign); (3) *Ambiguous Sign/Pantomime Gestures* can be interpreted either as pantomime or as signs; however, the pantomime involves a different meaning than the sign (e.g., the movement in the "tying a shoelace" pantomime resembles the ASL sign NECKLACE, not SHOE); (4) *Pure Signs* are noniconic ASL signs that do not resemble conventional pantomime. There were six gestures in each group, comprising a total of 24 trials presented in random order.

Children were seen individually with a caretaker and were first permitted to play freely with each of the 24 test objects. They were then tested for their knowledge of both the names (verbal or sign) and the gestures associated with each test object. The children's comprehension of names (verbal or sign) was assessed for each test object using a matching object-to-picture identity game.

¹⁰The design of this study underwent several evolutions. Both Elizabeth Bates and Barbara O'Connell contributed to the original design of this study while I was working with them at The Salk Institute and UCSD in 1983; I wish to thank them for their support and important insights. Major modifications were made to the study's design subsequent to that time as a result of three pilots that I conducted in Montréal (see, Petitto, in preparation).

This condition was important as part of an extensive pretraining period to ensure that the children fully understood the experimental task. The children were then given a multiple-choice gestural comprehension task using the four groups of gestures. The critical questions were whether children at different ages would comprehend conventional, iconic gestures and would interpret ambiguous gestures as signs or pantomimes.

If knowledge of the semantic (and syntactic) role of lexical forms has its roots in prelinguistic gestural behavior, then children who can (a) comprehend and produce names for common objects (e.g., *comb*) and (b) produce a functionally appropriate gesture with the object (e.g., raising comb to hair and "combing") should be able to comprehend a gesture for that same object, particularly if the gesture is nearly identical in form to the one that they themselves produced for the same object.

The surprising finding of the study was that neither deaf nor hearing children comprehended highly iconic conventional gestures (groups 1–3) at an early age. This was true even for objects that they spontaneously named or had produced gestures with. Instead, children between 22 through around 28 months performed randomly on these groups. Even though many of the gestures used were the ones that the children themselves had produced moments before the trial, they did not comprehend them. In fact, both deaf and hearing children were unable to understand the meanings of the iconic gestures (even those that shared fundamental properties with ASL signs) until they were around 33–34 months, far too late for them to have contributed to their own early vocabulary learning. Further, the children's overall ability to comprehend gestures increased with age. As expected, deaf children were consistently better on group 4 (pure signs) throughout, whereas hearing children performed randomly on this group. Finally, for group 2 (ambiguous sign/pantomime gestures) it was only around age 40–48 months that a clear distinction emerged; deaf children favored a sign interpretation of the gestures and hearing children a gestural one.

The deaf and hearing children's failure to comprehend gestures, even when they had spontaneously produced similar gestures with the objects, raises important questions about the referential, linguistic status of the child's gesturing with objects. I contend that such gestures are not "functionally equivalent" to linguistic naming—these findings demonstrate the fundamental nonlinguistic nature of the children's object-linked gestures. Rather than being names for objects, these gestures appear to be part of the activity of using them; by age 22–28 months the children's use of gestures seems to reflect their knowledge of what one does with the objects that is, their functions. Interestingly, this functionally based knowledge appeared to be distinct from their knowledge and use of meaningful, linguistic symbols for representing objects. Both deaf and hearing children failed to perceive the iconicity inherent in the gestures presented to them. It appeared that the gestures were not meant to designate or categorize an object as belonging to a known class (i.e., they did not "stand for" the referent *per se*) but

more closely resembled actions associated with them. Hence, when they observe the gesture in the task, they do not interpret them as names.

Finally, contrary to expectation, the deaf children's ability to comprehend gestures was not facilitated by the fact that gesture and sign share a single modality. Despite the close relationship between nonlinguistic and linguistic forms in ASL, deaf children's comprehension of nonlinguistic gestures was not advanced. Hence, we are provided with additional evidence for the distinct ways in which these children approach linguistic and nonlinguistic information even when they share a single channel.

GENERAL DISCUSSION

The three studies discussed in this chapter addressed two central theoretical questions in child language: What types of knowledge are involved in the acquisition process, and how does this knowledge change over time? Collectively, they provide evidence that the capacity to engage in prelinguistic gestural communication is distinct from the capacity to engage in linguistic expression.

In the first study, a radical discontinuity was observed between the deaf children's use of prelinguistic communicative pointing and the linguistic expression of YOU and ME pronouns, despite the fact that both forms were nearly identical. In the second study, detailed analyses of the forms, functions, and use of young children's prelinguistic gestures demonstrated that they differed from names in crucial ways. Finally, in the third study, hearing and deaf children (ages around 22–33 months) did not comprehend the conventional (iconic) gestures for objects that they themselves produced. The children's failure to comprehend these gestures calls into question the referential status of the gestures they produced for the same objects and provides additional evidence that the gestures the children produce do not have the same linguistic status as their names for the referents.

If these conclusions are correct, they suggest that the important issue is not the role of gesture in language acquisition, but rather why children gesture at all and why the use of gestures eventually declines. Children use gestures despite differing environments and cultures. The spontaneous onset of hearing and deaf children's gestures occurs around the same time (about 8–9 months) and begins to decline in frequency and type at around the same time (about 20–22 months). If this behavior does not represent the early expression of linguistic competence, why does it occur?

One possibility is that gestures are an early means to stimulate communicative interactions between the child and adults. Children's gestures generally attract adults' attention and response; adults respond by supplying linguistic information as, for example, when the child points and adults supply names or engage in a variety of other child-focused activities. Use of many gestures entails a highly

social exchange between parents and their infants; this is most often seen in the rituals that parents and children engage in such as peek-a-boo, patty-cake, and the like. Social gestures are highly susceptible to imitation in the young child (e.g., hello, bye-bye). Gesturing with objects may also help the child learn general perceptual and cognitive information regarding proximal-distal, visual-spatial relations, weight and mass relations, and to acquire functional information about what one does with objects. Rather than providing the basis for *communicating about* objects through naming, the child *obtains* information by using gestures.

It is interesting that some early gestures—indexical points, as well as showing and giving actions—do seem to be used by children with communicative, instrumental, and referential intent. Why, then, are we not justified in assigning linguistic status to such gestures? These particular attributes of early gestural use have led some researchers to regard them as nascent linguistic markers (see especially, Bates, 1976; Bruner, 1975; Clark, 1978; Werner & Kaplan, 1963). However, these studies allow us to move beyond the initial observation that prelinguistic infants are social, intentional beings to a closer evaluation of whether these properties—intentionality and the like—are sufficient to account for linguistic symbolization. It seems clear that it is fully possible for a child to be intentional, knowledgeable, communicative, and referential and yet not be engaging in a specifically linguistic act—as other distinctive properties of linguistic communication simply are not present. I am arguing that indexical pointing differs significantly from the way words are used to refer and that we are thus not justified in thinking of points to objects as names for those objects.

Why does the use of gestures decrease dramatically around 20–22 months? Shatz (1985) wonders whether the child's use of the early gestural system is only "an intermediary interaction device with just enough communicative features to carry out its function of eliciting interaction or whether it is continuous with either later gestural accompaniments to speech or the development of a linguistic system in the gestural mode" (page, 17). She suggests that the gestural system might be an intermediary system encouraging communicative interaction and consequent linguistic input. Shatz further suggests that because hearing children's attention shifts around 20 months to interword relations during the multiword phase of language development, their production of gestures consequently drops dramatically (p. 18). My findings corroborate Shatz's general observation. The evidence from the acquisition of sign language in deaf children (as well as ape language studies) suggests that hearing and deaf children's inclination to use gestural communication is temporary and more important, distinct from later linguistic expression (see also Abrahamsen, Cavallo, & McCluer, 1985). The clearest evidence for this claim is found by observing how children approach the task of language learning where gestural and linguistic units are in the same mode. What is amazing is that, from the outset, deaf children tacitly seem to comb through the language input for units that are potentially significant to the

target language, much the way hearing children first seem to extract phonemic features from a diffuse sound stream. Thus, regardless of the modality, children seem to isolate and separately analyze just those units—be they visual or aural—that will ultimately be significant to their language. This division between what is *in* their language and what is *outside* of it begins surprisingly early and is especially apparent when the language in question is externally articulated and resides in the same channel as gestures. The way deaf infants enter this process and begin differentiating among types of information within the single channel implies that a priori domain-specific—but not channel-specific—constraints must be at work during language acquisition.

It should be noted that, because many gestures are not universal, children must learn the specific gestures used in their culture. From around 13 months to 18–20 months, just before the extensive use of gesturing declines, children's gesturing with objects becomes more finely tuned to the specific functions associated with them, suggesting that learning which gestures belong to which objects must take place. Further, just as it is incorrect to assume that grammatical categories are "given" in the environment, it is incorrect to assume that knowledge of how to use gestures is directly apparent from relations given in the child's environment. Researchers who assert that perceptually salient information in the environment guides the child's use of gestures are implicitly ascribing an overly powerful theory of mind to the child. In trying to minimize the special status of language as a distinct domain of knowledge they have swung the other way, making claims about the child's general cognitive capacities that are equally implausible (see also Slobin, 1982). The environment provides the child with a potentially infinite number of ways to encode an object or event gesturally, which, in reality, cannot be exploited by the child. What, then, constrains the child's use of gestures? In maintaining that the 13-month-old's gestures are linguistic, researchers must provide an answer to this question. Finally, why do children favor linguistic rather than gestural means of encoding referents during times when, if the theory were correct, both systems are available to them? An explanation is not provided by asserting that "[gestures] remain too tied to their objects to move into flexible predicative relations", and "[gestures] are not used in communication [by the child], so that there is less pressure toward conventionalization and extension of use" (Bates et al., 1983). If anything, this argument describes the way in which gestures are distinct from linguistic expression. Further, it does not explain how deaf children differentiate between, and treat as distinct, gestural and linguistic information in cases where both gesture and sign are produced with identical forms.

The preceding analysis of the distinction between linguistic and nonlinguistic domains of knowledge is further validated by considering again the gestures of apes. My intention here is to illuminate some potentially interesting behavioral similarities and dissimilarities between child and chimp in light of the preceding discussion. Perhaps the most common feature in research involving child and

chimp signing is the researchers' propensity to overattribute linguistic meanings to their gestures. Leaving aside this methodological issue, there are other points of comparison. The behaviors of the young child—hearing and deaf—and chimp appear most similar in their general communicative and social interactions with people in their environment. By 12 months of age the cognitive abilities of both child and chimp are impressive: Both demonstrate possession of object permanence, both manipulate and handle objects, often in appropriate ways, both engage in social games (like patty-cake), and both explore the world around them. Both possess a set of natural gestures (including the open–close gesture) that are used across multiple contexts for multiple referents. Most importantly, both appear to be intentional beings and are able to use gestures to achieve instrumental ends. Both remember aspects of their daily routines and anticipate them; both recognize their caretakers; finally, both seek out and are part of social activities with adults.

The behaviors of hearing and deaf children and chimpanzees are very similar until around 12–13 months of age. At this point, hearing and deaf children effortlessly begin to experiment with their first names for things—one literally cannot stop them from naming—whereas the chimpanzee never takes this next step. Instead, into the chimpanzee's fifth year of life, and beyond, the training of simple vocabulary remains an extraordinarily arduous task. Teaching the chimpanzee the sign for CUP, for example, even with a cup physically present and in the chimpanzee's hands, can take literally thousands of trials, a fact well known among ape researchers, but little publicized. One noteworthy exception is a paper by Savage-Rumbaugh & Rumbaugh (1978), where they noted that their apes failed to learn six object names after 4 months of intensive training and over 3,000 trials. They concluded that "contrary to expectation, the subjects still demonstrated no reliable ability to name an object with a small lexigram symbol (page 273)". Moreover, it has been nearly impossible to teach apes (Nim and others) superordinate categories like *eating utensil* where there is no unique referent for the kind "utensil," only exemplars of the kind (e.g., forks and knives). Because apes do not grasp the special relationship between a sign and its referent (described as "scope of referring relations" in the discussion of names), it is little wonder that they do not combine signs syntactically; apes do not appear to understand that signs *refer*. They appear to know only that signs *effect*—cause some reaction or change in their environment. As my experience with Nim suggested, apes have knowledge about the pragmatic consequences of their hand gestures but not of the linguistic power of signs themselves.

A final observation about chimpanzees is that they do not use the indexical point to denote referents communicatively. Although it has been claimed that they do, this appears to be a misattribution, researchers having failed to distinguish among the various types of pointing that human infants typically engage in (see Bates et al., 1975). Although apes do produce exploratory pointing to objects that are physically in hand, they do not point to a referent while moving eye gaze to and fro between the referent and the caretaker to establish joint visual

regard. Interestingly, although chimpanzees will reach towards and beg for food (and other desirable objects), they will not point to the objects. Even after several years of training, the ape's use of the point differs markedly from that of a child. Chimpanzees simply do not spontaneously point to pick out and denote objects.

The developmental moment when the deaf or hearing child departs from the ape is when he or she begins to refer to and represent his or her world with linguistic symbols rather simply enacting actions with gestures. Moreover, around 18–22 months there appears to be a fundamental reorganization in children's knowledge manifested in strong discontinuities between linguistic and nonlinguistic knowledge systems (e.g., see Bowerman, 1982a, 1983b; Karmiloff-Smith, 1986). One particularly clear example of reorganization is seen in the acquisition of pronouns where the deaf child shifts from conceptualizing person-pointing as part of the class of deictic gestures to viewing such gestures as elements within the linguistic (lexical) system of ASL. Evidence from the other studies bearing on the issue of reorganization was seen in the very different ways children used gestures compared to linguistic symbols and in the children's failure to understand gestures as representing or naming objects. The cognitive or neurological basis for this reorganization is unclear and needs to be further investigated. However, the existence of the phenomenon cannot be doubted.

CONCLUSIONS

Language acquisition models that propose either a "direct mapping" from prelinguistic to linguistic expression, or a common underlying cognitive capacity that drives the symbolization process are not supported by the data from the studies described here. I do not suggest that there is no relationship between prelinguistic and linguistic knowledge, or that language acquisition is unrelated to cognitive development. I contend, however, that linguistic knowledge (concerning, for example, the relationship between form and meaning, and relations among forms) is not merely constructed out of the nonlinguistic materials at hand. In this sense, then, these studies compel the conclusion that central aspects of the language acquisition process are distinct from other forms of knowledge.

It is time once again to reintroduce specifically linguistic analyses in the field of "child language." Psychologists have recently shown antipathy to linguistics, perhaps because the field has become more complex. At times, linguists' controversies seem inscrutable to those of us on the sidelines. Further, the temptation to study gestures and other aspects of social interaction is great, because such external behaviors lend themselves to direct observation. However, an understanding of human language acquisition can only be achieved, I believe, with sophisticated and detailed analyses of the child's acquisition of linguistic phenomena per se. The challenge is to specify exactly what constitutes knowledge of *language* and how it evolves in ontogenesis. This requires an explicit theory of language, as part of a more general theory of language acquisition. Only a theory

that considers the facts of language acquisition as well as the child's cognitive and developmental growth will succeed. Seen from this perspective, "learnability theory" is an important recent advance in theorizing, as it lays out a comprehensive program for what any adequate theory of language acquisition will necessarily have to specify (see especially the chapter in this text by Pinker and other important works on this topic: e.g., Pinker, 1979, 1984; Wexler & Culicover, 1980).

Roger Brown has always recognized the need for specific grammatical and semantic analyses in child language. This is clear not only from his published works, but also from the historical artifacts left behind in my office at Harvard. Looming behind my desk as I worked were seven wall-length shelves of the original audiotapes and phonetic transcriptions of Adam, Eve, and Sarah. Among the many artifacts (including Melissa Bowerman's notes from an anthropology class, Ursula Bellugi's Sage's shopping bag, a Lost-in-Space toy robot from 1967, and a five-pound box of sugar with a price of 89 cents) were hundreds of pages of Roger's notes. Writing by hand in pencil on yellow lined paper, he had carefully mapped out various grammars and semantic analyses for the three children. In the very late hours of a typical graduate student's day, I would find myself reading through these notes; I have learned tremendously from them as I have from Roger himself. If the present studies contribute to our understanding of child language, it is because they were inspired by his brilliant insights.

ACKNOWLEDGMENTS

I thank Mark Seidenberg for his important and insightful comments on earlier drafts of this chapter. I thank Frank Kessel and John Macnamara for their helpful comments on an earlier draft of this chapter. Special thanks to Fernande Charron and Robert Dufour for assisting in many aspects of this research. I thank my deaf research assistant, France Boulanger, for assisting with the transcription of videotapes. The data for Study 1 were reported in my Doctoral Dissertation (Harvard U.) and were collected at The Salk Institute for Biological Studies, La Jolla, California, in Ursula Bellugi's laboratory; I am very grateful for her generous support and guidance. This research was funded by a fellowship from the John D. and Catherine MacArthur Foundation's "San Diego Node" (Elizabeth Bates, Director), a NIH grant (#NS1151175) to U. Bellugi, and two grants from Canada: NSERC and F.C.A.R. (Québec).

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